5 QUALITY ASSURANCE PROCEDURES

Random Numbers

Design Mix Formula

Lot/Sublot -- QC/QA HMA

Acceptance Samples

Adjustment Period -- QC/QA HMA

Mixture Acceptance
- **QC/QA HMA**
- **HMA**

Pay Factors -- QC/QA HMA
- **Mixture**
- **Density**

Mix Appeal -- QC/QA HMA

Adjustment Quantity -- QC/QA HMA

Mixture Adjustment Factor

5 CHAPTER FIVE: QUALITY ASSURANCE PROCEDURES

The acceptance criteria for QC/QA HMA set out in the Quality Assurance Specifications are based on binder content, air voids @ N_{des}, VMA @ N_{des}, density and smoothness. The Standard Specifications establish controls for temperature and moisture content of the mixture, testing of aggregates for quality, and testing of binder. The acceptance criteria for HMA mixtures are based on binder content, CAA for mixtures containing gravel, gradation, and air voids.

This section includes the procedures for obtaining acceptance samples, minimum requirements for mixture properties in accordance with Section **401** and **402** of the Standard Specifications, and the procedures for determining pay factors.

RANDOM NUMBERS

Sampling for mixture tests is done on a random basis using **ITM 802** (Appendix A). A table of Random Numbers as shown on Form TD-458 (Figure 5-1), is used to determine the random quantity or random location. The numbers occur in this table without aim or reason and are in no particular sequence. Therefore, samples obtained by the use of this table are truly random or chance, and eliminate the technician's bias in obtaining samples.

To use this table to determine the random ton to sample, select without looking one block in the table. After selecting the block, the top left number in the block is the first random number used. This number will be the beginning number. Proceed down the column for additional numbers and proceed to the top of the next column on the right when the bottom of the column is reached. When the bottom of the last column on the right is reached, proceed to the top of the column at the left. If all numbers in the table are used, select a new starting number and proceed in the same manner.

To use this table to determine the location of the pavement sample, again select a block in the table and start with the top left number. This number will be used to determine the test site station. The adjacent number within the block will be used to determine the transverse distance to the random site. Proceed down by pairs until the bottom numbers are reached and proceed to the adjacent top block to the right, if available. When the bottom pair of numbers on the right are reached, proceed to the top block on the left in the table.

TD-458

RANDOM NUMBERS

.576	.730	.430	.754	.271	.870	.732	.721	.998	.239
.892	.948	.858	.025	.935	.114	.153	.508	.749	.291
.669	.726	.501	.402	.231	.505	.009	.420	.517	.858
.609	.482	.809	.140	.396	.025	.937	.310	.253	.761
.971	.824	.902	.470	.997	.392	.892	.957	.040	.463
.053	.899	.554	.627	.427	.760	.470	.040	.904	.993
.810	.159	.225	.163	.549	.405	.285	.542	.231	.919
.081	.277	.035	.039	.860	.507	.081	.538	.986	.501
.982	.468	.334	.921	.690	.806	.879	.414	.106	.031
.095	.801	.576	.417	.251	.884	.522	.235	.389	.222
.509	.025	.794	.850	.917	.887	.751	.608	.698	.683
.371	.059	.164	.838	.289	.169	.569	.977	.796	.996
.165	.996	.356	.375	.654	.979	.815	.592	.348	.743
.477	.535	.137	.155	.767	.187	.579	.787	.358	.595
.788	.101	.434	.638	.021	.894	.324	.871	.698	.539
.566	.815	.622	.548	.947	.169	.817	.472	.864	.466
.901	.342	.873	.964	.942	.985	.123	.086	.335	.212
.470	.682	.412	.064	.150	.962	.925	.355	.909	.019
.068	.242	.777	.356	.195	.313	.396	.460	.740	.247
.874	.420	.127	.284	.448	.215	.833	.652	.701	.326
.897	.877	.209	.862	.428	.117	.100	.259	.425	.284
.876	.969	.109	.843	.759	.239	.890	.317	.428	.802
.190	.696	.757	.283	.777	.491	.523	.665	.919	.146
.341	.688	.587	.908	.865	.333	.928	.404	.892	.696
.846	.355	.831	.218	.945	.364	.673	.305	.195	.887
.882	.227	.552	.077	.454	.731	.716	.265	.058	.075
.464	.658	.629	.269	.069	.998	.917	.217	.220	.659
.123	.791	.503	.447	.659	.463	.994	.307	.631	.422
.116	.120	.721	.137	.263	.176	.798	.879	.432	.391
.836	.206	.914	.574	.870	.390	.104	.755	.082	.939
.636	.195	.614	.486	.629	.663	.619	.007	.296	.456
.630	.673	.665	.666	.399	.592	.441	.649	.270	.612
.804	.112	.331	.606	.551	.928	.830	.841	.702	.183
.360	.193	.181	.399	.564	.772	.890	.062	.919	.875
.183	.651	.157	.150	.800	.875	.205	.446	.648	.685

Figure 5-1. Random Numbers

DESIGN MIX FORMULA

The Producer is required to submit for the Engineer's approval, a Design Mix Formula (DMF) for each mixture. This information is recorded in a format acceptable to the Engineer. TD-451 is one format that has been used for this purpose. (Figure 5-2). INDOT is required to have a copy of the DMF prior to production of any mixture.

LOT/SUBLOT -- QC/QA HMA

Quality Assurance Specifications consider a lot as 4000 t of Base or Intermediate QC/QA HMA and 2400 t of Surface QC/QA HMA. The lots are divided into four sublots of equal tons. For Base and Intermediate QC/QA HMA therefore, a sublot is 1000 t and for Surface QC/QA HMA, a sublot is 600 t. Partial sublots of 100 t or less are added to the previous sublot. Partial sublots greater than 100 t constitute a full sublot.

ACCEPTANCE SAMPLES

Sampling of mixture for acceptance is made from the pavement in accordance with **ITM 580**. INDOT determines the random site and the Contractor obtains the samples under INDOT supervision.

A specific ton in each sublot is selected and the mixture from the truck containing that ton is sampled. This truck is determined by checking the weigh tickets. An example of how to determine what ton is to be sampled is shown on form TD-452 (Figure 5-3). These random tons are not shown to the Contractor so that there will be no possible influence on the construction operations.

Once the truck that contains the random ton is identified, the approximate total length of mixture that the truck will place is determined by knowing the weight of the truck, the paving width, and the quantity placed. When placing variable depth, such as a crown correction, the average depth should be used. The following relationship is used to calculate this approximate length.

$$\text{Length of Load (Nearest Foot)} = \frac{\text{Load Weight (t)}}{\text{Avg. Planned Quantity (lb/yd}^2\text{)} \times \text{Width of Paving (ft)}} \times 18000$$

State Form XXXXX (R3/07-2002)

INDIANA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TEST DIVISION

SUPERPAVE DMF/JMF COVERSHEET

CONTRACTOR: J. Wooden Const.
MIX PRODUCER: J. Wooden Const.
PLANT LOCATION: W. Lafayette
PLANT NO.: 3550
MIX DESIGN LAB: 0149

DATE: 7-21-02
CONTRACT: R-3000
ROAD NO.: I-65
DISTRICT: Crawfordsville
REF. JMF: ____ (Contract JMF No.)

MATERIAL SOURCES

COARSE AGG. (SOURCE & LEDGE):
2421 - Ledges 1-5, #8's
2421 - Ledges 1-5, #11's

FINE AGG. (NAT./MAN. & SOURCE):
2421 - Ledges 1-5

PG BINDER (TYPE & SOURCE):
PG 70-22, 7101

ANTI-STRIP AGENT & DOSAGE RATE:
None Required

DESIGN MIX FORMULA / JOB MIX FORMULA

DMF/JMF number	0110133	
Material code	3222	
ESAL	15,000,000	
Mixture type	19.0 mm Int.	
Maximum particle size	1 in.	
	MASS	VOLUME
% Pass 1 1/2 in.		
% Pass 1 in.	100	
% Pass 3/4 in.	95.3	
% Pass 1/2 in.	81.0	
% Pass 3/8 in.	——	
% Pass No. 4	——	
% Pass No. 8	25.0	
% Pass No. 30	10.5	
% Pass No. 200	4.2	
Gsb	2.682	
Mix temperature min. °F	260	
Mix temperature max °F	325	
RAP % in mixture	0	
RAP binder % extracted	—	

Ignition oven test temp. °F	1000
Ignition oven calibration factor	0.42
Ignition oven serial number	21
Binder % actual (ig. ov.)	4.5
Binder % extracted	4.3
MSG w/ dry back Yes or No	No
Gyrations Nini/Ndes/Nmax	8/100/100
Density, kg/m^3 @ Ndes	151.6
Gmb (plot/calculate) @ Nmax	2.480
Gmm (plot/calculate)	2.538
% Air voids @ Ndes	4.3
VMA @ Ndes	13.5
VFA @ Ndes	68.1
Coarse aggregate angularity	——
Fine aggregate angularity	48.0
Sand equivalency	85.0
Dust/calculated effective binder	1.00
Tensile strength ratio	86.9

CONTRACTOR SIGNATURE: _____ DATE: _____

DMTE OR PE SIGNATURE: _____ DATE: _____

Figure 5-2. Design Mix Formula

TD-452 State Form 36667 (R3/3-95)

COPIES TO:
DISTRICT TESTING ENGINEER
FILE

INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS

RANDOM SAMPLING FOR MIX ANALYSIS

Contract No. R-20396 LOT No. 4

District Greenfield Mixture 19.0 mm Intermediate

DATE SAMPLED: SUBLOT 1 6/9/01 SUBLOT 2 6/9/01 SUBLOT 3 6/10/01 SUBLOT 4 6/10/01

SUBLOT NO.	SUBLOT TONS	RANDOM NO.	RANDOM TON	LOT TON TO BE SAMPLED		PAVING WIDTH	RANDOM NO.	TRANS. LOC.	LENGTH OF LOAD	RANDOM NO.	RANDOM DIST.	STARTING STA.*	RANDOM STATION
	A	B	A x B = C	D	C + D	E	F	E x F	G	H	G x H = I	J	I + J
1	600			0									N.B. Passing
	1000	.123	123	0	123	12	.100	1.2 (1)	136	.259	35	10+50	10+85
2	600			625									N.P. Passing
	1000	.116	116	1000	1116	12	.890	10.7 (11)	136	.317	43	76+90	77+33
3	600			1250									N.B. Passing
	1000	.836	836	2000	2836	12	.523	6.3 (6)	136	.665	90	194+00	194+90
4	600			1875									N.B. Passing
	1000	.636	636	3000	3636	12	.928	11.1 (11)	136	.404	55	247+20	247+75

* *STATION OF PAVER WHEN TRUCK CONTAINING RANDOM TON BEGINS UNLOADING.*

$$\text{Length of Load (Nearest Foot)} = \frac{\text{Load Weight (tons)}}{\text{Avg. Planned Quantity (lb./sq. yd.)} \times \text{Width of Paving (ft.)}} \times 18000$$

Signed _____

Figure 5-3. Random Sampling for Mix

The length the truck will place is multiplied by the first random number to obtain a longitudinal distance. This distance is measured from the location of the paver when the truck containing the random ton begins unloading into the paver or material transfer device. The transverse test site location is determined by multiplying the width of pavement by the second random number and rounding to the nearest whole foot. This distance is measured from the right edge of pavement when looking in the direction of increasing station numbers. If the transverse location is less than 1 ft from either edge of pavement, at a location where the course thickness is less than 2.0 times the maximum particle size, or within the width of the roller drum used to form shoulder corrugations, then another random location is selected to obtain an acceptable sampling location. The following example shows how these random locations are determined.

Example

Width of Pavement	= 12 ft
Load Weight	= 20 t
Mixture	= 9.5 mm Surface
Planned Quantity	= 110 lb/yd^2
Ending Station of Paver of Previous Load	= 158+00
Random Numbers	= .256, .561

Test Site Station

$$\text{Length of Load} = \frac{20}{110 \times 12} \times 18000 = 273 \text{ ft}$$

Longitudinal Distance = 273 x .256 = 70 ft
Random Station = (158+00) + 70 = 158+70

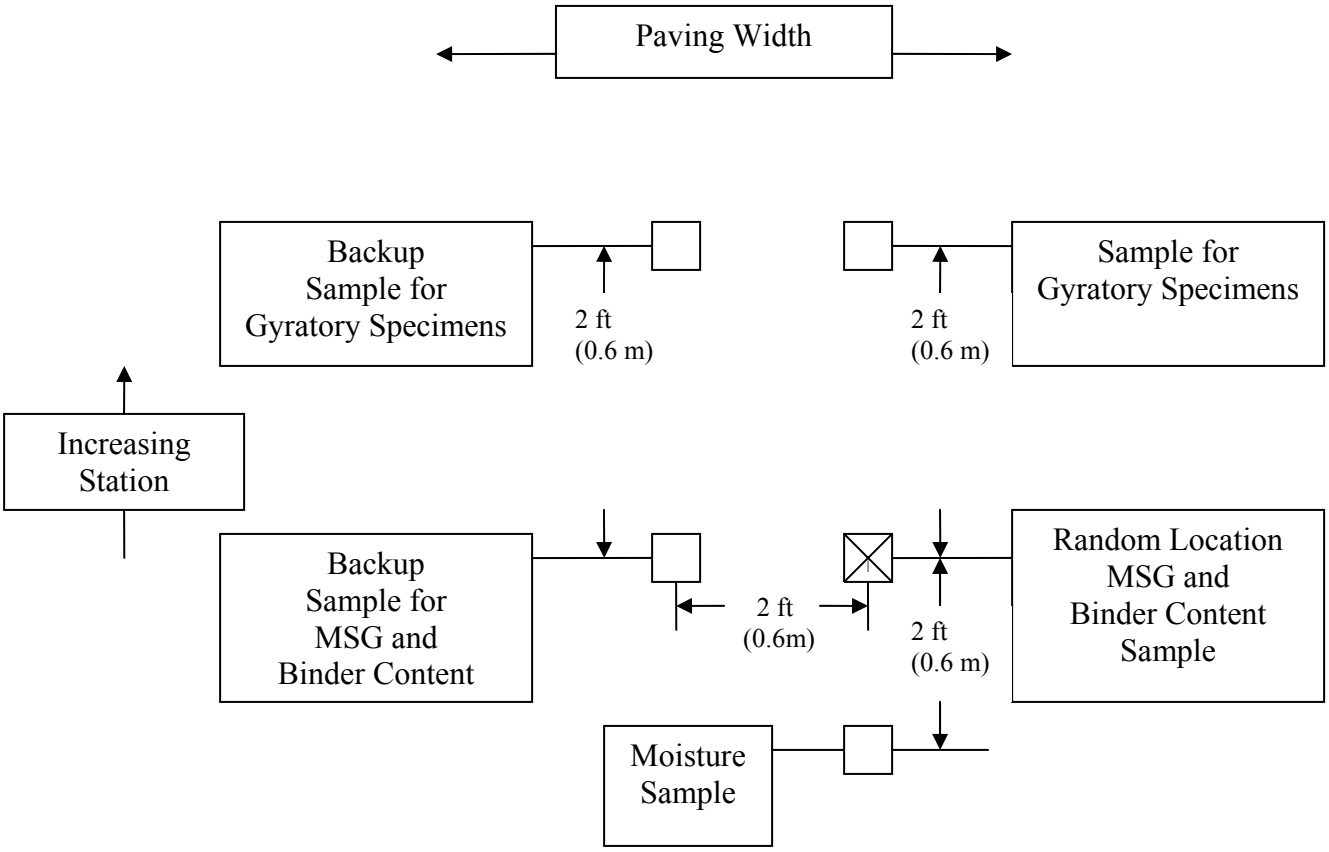
Transverse Distance

Distance = 12 x .561 = 6.7 ft (say 7 ft)

For contracts controlled by volumetrics in accordance with Section 401 of the Standard Specifications, additional samples are required. The first plate sample location is determined by the random sampling procedure and this material is used for the maximum specific gravity and binder content samples. A second plate sample is placed longitudinally 2 feet upstation from the first plate at the same transverse offset. This sample is used for the gyratory specimens. For a QC/QA HMA surface mixture, a moisture sample is required. A third plate for the moisture sample is placed longitudinally 2 feet backstation from the first plate at the same transverse offset.

If an appeal by the Producer of the INDOT test results is accepted, backup samples are tested. These samples are obtained at the same time as the acceptance samples. The backup sample plate for the maximum specific gravity and binder content is placed transversely 2 feet from the first plate towards the center of the mat. The backup sample for the gyratory specimens is placed transversely 2 feet from the second plate towards the center of the mat.

The following diagram shows an example of an arrangement of the plate samples when additional samples are required for volumetrics:



Using the example on pg. 5-6, the sample locations are determined as follows:

MSG and Binder Content Sample
Random Location = 158 + 70
Transverse Distance = 7 ft

Gyratory Specimens Sample
Random Location = (158 + 70) + 02
= 158 + 72

Transverse Location = 7 ft

Moisture Sample (Surface Mixture Only)
Random Location = (158 + 70) - 02
= 158 + 68
Transverse Location = 7 ft

Backup Sample for MSG and Binder Content
Random Location = 158 + 70
Transverse Distance = 7-2
= 5 ft

Backup Sample for Gyratory Specimens
Random Location = (158 + 70) + 2
= 158 + 72
Transverse Distance = 7-2
= 5 ft

The size of the plate used to obtain a sample is dependent on the test (s) conducted on the material. The following minimum sample weights are required:

Mixture Designation	Minimum Weights (g)		
	Moisture	MSG and Binder Content	Gyratory Specimens
4.75 mm	1000	1200	11,000
9.5 mm	1500	3000	11,000
12.5 mm	2000	4000	11,000
19.0 mm, C19.0 mm	3000	5500	11,000
25.0 mm, C25.0 mm	4000	7000	11,000
37.5 mm	6000	10,500	11,000

Included below are the approximate weights that may be obtained for various sizes of plates and depths of mixture that are placed:

Approximate Sample Yield for Various Lift Thickness and Plate Sizes									
Lift Thickness	Lay Rate	Plate Size, inches							
Inches	lb/syd	8	9	10	11	12	14	16	18
		Sample Weight (g)							
1.25	137.5	3100	3900	4800	5900	7000	9500	12400	15700
1.5	165	3700	4700	5800	7000	8400	11400	14900	18800
1.75	192.5	4300	5500	6800	8200	9800	13300	17300	21900
2	220	5000	6300	7700	9400	11100	15200	19800	25100
2.25	247.5	5600	7100	8700	10500	12500	17100	22300	28200
2.5	275	6200	7800	9700	11700	13900	19000	27800	31400
2.75	302.5	6800	8600	10600	12900	15300	20900	27300	34500
3	330	7400	9400	11600	14100	16700	22800	29700	37600
3.25	357.5	8100	10200	12600	15200	18100	24700	32200	40800
3.5	385	8700	11000	13500	16400	19500	26600	34700	43900
3.75	412.5	9300	11800	14500	17600	20900	28500	37200	47000
4	440	9900	12500	15500	18700	22300	30300	39600	50200

ADJUSTMENT PERIOD -- QC/QA HMA

The Producer is allowed an adjustment period for each mix design in which the mix design is verified and changes can be made in the DMF, if necessary. A job mix formula (JMF) is submitted for approval to the Engineer upon completion of the adjustment period. The adjustment period is from the beginning of production and extending until 4000 t of base or intermediate or 2400 t of surface QC/QA HMA has been produced for each mix design. The production is for one contract. A reduced adjustment period is allowed. If production extends into the next construction season, another adjustment period is allowed.

MIXTURE ACCEPTANCE

QC/QA HMA

Acceptance of QC/QA HMA mixtures for binder content, VMA at N_{des}, and air voids at N_{des} for each lot will be based on tests performed by INDOT. Acceptance testing for surface mixtures will include tests for moisture content. INDOT will randomly select the location(s) within each sublot for sampling in accordance with the ITM 802.

Samples from the pavement shall be obtained from each sublot in accordance with ITM 580. The test results for each sublot shall meet the requirements for the tolerances from the JMF as shown in the table as follows:

ACCEPTANCE TOLERANCES	
MIXTURE PROPERTIES	TOLERANCES FROM JMF
DENSE GRADED	
Air Voids	JMF ± 1.0%
Binder Content	JMF ± 0.5%
VMA	JMF ± 1.0%
OPEN GRADED	
Air Voids *	JMF ± 3.0%
Binder Content	JMF ± 0.5%

* Gmb will be determined in accordance with ASTM D 6752

The maximum percent of moisture in the mixture shall not exceed 0.10 from plate samples. A binder drain down test in accordance with AASHTO T 305 for open graded mixtures shall be completed once per lot and shall not exceed 0.50%. The acceptance test results for each sublot will be available when the testing is complete.

HMA

Acceptance of HMA mixtures is done on the basis of a Type D certification submitted by the Producer to the Project Engineer on a contract. An example of this form is shown in Figure 5-4. The certification is required to be submitted with the first truck of each type of mixture each day. The test results required on the certification should be the most recent test results available from the Certified HMA Producer. If the mixture is from a new DMF or the first mixture of the year for a JMF and no test results are available, the Producer shall indicate on the form that test results shall be submitted when completed. Samples are required to be obtained within the first 250 tons and test results submitted to the Project Engineer within 48 hours of the time the samples were taken.

9/24/02

INDIANA DEPARTMENT OF TRANSPORTATION
HOT MIX ASPHALT (HMA) CERTIFICATION

CONTRACT NUMBER RS – 30000 DATE 5/3/03

CERTIFIED HMA PRODUCER J.Wooden Construction

CERTIFIED HMA PLANT NUMBER 3550

DMF/ JMF NUMBER 0310075

MIXTURE TYPE AND SIZE HMA Surface, 9.5 mm , Type A

DESIGN ESAL 200,000

This is to certify that the following test results for Air Voids and Binder Content represent the HMA mixture furnished to this contract:

Air Voids 4.3 (± 1.5 % from DMF) Binder Content 5.7 (± 0.7 % from DMF/JMF)

* [ ] First test of DMF / JMF for the year. A production sample shall be taken within the first 250 t (250 Mg) produced and test results submitted within 48 h of the time the sample was taken.

* ✓ If Applicable

Signature of HMA Producer Official

Title of Official

FOR PE/PS USE ONLY

PAY ITEM(S) _____ BASIS FOR USE NO. C999998

SPECIFICATION REFERENCE

__ 304.04 - Patching	__ 402.07(c) - Temporary HMA	__ 610.02 - Approaches
__ 304.05 - Widening	__ 503.03(e) - Terminal Joints	__ 611.02 - Crossovers
__ 402.04 - HMA Pavements	__ 507.05(b) - Partial Depth Patching	__ 718.04 - Underdrains
__ 402.07(a) - Rumble Strips	__ 604.07(c) - Sidewalk	__ 801.11 - Temp. Crossovers
__ 402.07(b) - Wedge & Leveling	__ 605.07(c) - Curbing	

Figure 5-4. HMA Certification

PAY FACTORS -- QC/QA HMA

After the tests are performed, the test data is evaluated for compliance with the specifications. Moisture tests and temperature tests are taken in accordance with standard procedures and recorded. Lot numbers begin with number 1 for each type of mixture and are continuous for the entire contract regardless of the number of adjustment periods for that type of mixture.

When the required tests for one sublot are completed, the difference between the values and that required on the JMF is determined and pay factors calculated. For mixtures produced during a plant's adjustment period, pay factors based on the JMF are used. A composite pay factor for each sublot is determined for the binder content, air voids @ N_{des}, VMA @ N_{des}, and density of the mixture as follows:

$$SCPF = 0.20(PF_{BINDER})+0.35(PF_{VOIDS})+0.10(PF_{VMA})+0.35(PF_{DENSITY})$$

where:

SCPF	=	Sublot Composite Pay Factor for Mixture and Density
PF_{BINDER}	=	Sublot Pay Factor for Binder Content
PF_{VOIDS}	=	Sublot Pay Factor for Air Voids at N_{des}
PF_{VMA}	=	Sublot Pay Factor for VMA at N_{des}
$PF_{DENSITY}$	=	Sublot Pay Factor for Density

If the SCPF for a sublot is less than 0.85, the pavement is evaluated by INDOT. If the Contractor is not required to remove the mixture, quality assurance adjustments of the lot will be assessed or other correction actions taken as determined by INDOT.

Mixture

Sublot test results for mixture properties are assigned pay factors in accordance with the following:

BINDER CONTENT	
Pay Factor	Deviation from JMF (± %)
1.05	≤0.2 and
1.04	>0.2 and ≤0.3
1.02	>0.3 and ≤0.4
1.00	>0.4 and ≤0.5
0.95	>0.5 and ≤0.6
0.90	>0.6 and ≤0.7
0.85	>0.7 and ≤0.8
0.85 - 0.05 per each 0.1% over 0.8%	>0.8

VMA	
Pay Factor	Deviation from JMF (± %)
DENSE GRADED	
1.05	≤0.5
1.00	>0.5 and ≤1.0
0.95	>1.0 and ≤1.5
0.90	>1.5 and ≤2.0
0.85	>2.0 and ≤2.5
0.85 - 0.02 per each 0.1% over 2.5%	>2.5
OPEN GRADED	
1.00	All

AIR VOIDS	
Pay Factor	Deviation from JMF (± %)
DENSE GRADED	
1.05	≤0.5
1.00	>0.5 and ≤1.0
0.95	>1.0 and ≤1.5
0.85	>1.5 and ≤2.0
Submitted to the Materials and Tests Division *	>2.0
OPEN GRADED	
1.05	≤1.0
1.00	>1.0 and ≤3.0
0.95	>3.0 and ≤3.5
0.85	>3.5 and ≤4.0
Submitted to the Materials and Tests Division *	4.0

* Test results will be considered and adjudicated as a failed material in accordance with normal INDOT practice as listed in 105.03.

Density

Sublot test results for density will be assigned pay factors in accordance with the following:

Pay Factors - Percent	Percentages are based on % MSG	
	Dense Graded	Open Graded
Submitted to the Materials and Tests Division *	≥97.0	
105 - 1.0 for each 0.1% above 95.5	95.6 - 96.9	
105	94.0 - 95.5	
100 + 0.5 for each 0.1% above 93.0	93.0 - 93.9	
100	92.0 - 92.9	84.0
100 - 0.2 for each 0.1% below 92.0	91.0 - 91.9	
98 - 0.4 for each 0.1% below 91.0	90.0 - 90.9	
94 - 1.0 for each 0.1% below 90.0	89.0 - 89.9	
Submitted to the Materials and Tests Division *	≤88.9	

* Test results will be considered and adjudicated as a failed material in accordance with normal INDOT practice as listed in 105.03.

The sublot pay factor for density will be the sublots pay factors shown above divided by 100.

Example

A 25.0 mm Base mixture has the following test results. Determine the Quality Assurance Adjustment.

Lot Size = 4000 tons
Unit Price = $28.00/ton
JMF % Binder = 4.2 %
Air Voids = 4.0 %
VMA = 12.5 %

	Sublot 1	Sublot 2	Sublot 3	Sublot 4
% Binder	4.5	4.6	4.8	4.2
Air Voids	3.8	3.7	3.2	4.7
VMA	12.2	12.1	11.6	13.4
Density (% MSG)	91.1	90.7	89.9	92.9

Using the pay factor charts, the following values are obtained:

	Sublot 1	Sublot 2	Sublot 3	Sublot 4
% Binder	1.04	1.02	0.95	1.05
Air Voids	1.05	1.05	1.00	1.00
VMA	1.05	1.05	1.00	1.00
Density (% MSG)	0.98	0.97	0.93	1.00

Calculations to determine the Quality Assurance Adjustment are shown in Figure 5-5.

INDIANA DEPARTMENT OF TRANSPORTATION

HOT MIX ASPHALT ANALYSIS FOR QUALITY ASSURANCE

CONTRACT NO. _____ PLANT NO. _____ LOT NO. _____ DATE _____

MIXTURE _____ DMF/JMF NO. _____

Mixture & Density	SUBLOT 1				SUBLOT 2				SUBLOT 3				SUBLOT 4			
	Dev. from JMF	Pay Factor A_1	Mult. B_1	A_1xB_1	Dev. from JMF	Pay Factor A_2	Mult. B_2	A_2xB_2	Dev. from JMF	Pay Factor A_3	Mult. B_3	A_3xB_3	Dev. from JMF	Pay Factor A_4	Mult. B_4	A_4xB_4
% Binder	0.3	1.04	0.20	0.21	0.4	1.02	0.20	0.20	0.6	0.95	0.20	0.19	0.0	1.05	0.20	0.21
Air Voids	0.2	1.05	0.35	0.37	0.3	1.05	0.35	0.37	0.8	1.00	0.35	0.35	0.7	1.00	0.35	0.35
VMA	0.3	1.05	0.10	0.11	0.4	1.05	0.10	0.11	0.9	1.00	0.10	0.10	0.9	1.00	0.10	0.10
Density		0.98	0.35	0.34		0.97	0.35	0.34		0.93	0.35	0.33		1.00	0.35	0.35
SCPF				1.03				1.02				0.97				1.01

* Requires submittal to the Materials and Tests Division for Failed Material Investigation

QUALITY ASSURANCE ADJUSTMENT						
Lot Quantity L (tons)	Sublot 1 $SCPF_1$	Sublot 2 $SCPF_2$	Sublot 3 $SCPF_3$	Sublot 4 $SCPF_4$	LPF	Adjustment Quantity LxUx(LPF-1.00) ($)
4000	1.03	1.02	0.97	1.01	1.01	+1120

U = Unit Price for Material, $/Ton

$$\text{Lot Pay Factor (LPF)} = \frac{SCPF_1 + SCPF_2 + SCPF_3 + SCPF_4}{\text{Number Of Sublots}}$$

Figure 5-5. Quality Assurance Adjustment

MIX APPEAL -- QC/QA HMA

If the Producer does not agree with the acceptance test results, a request may be submitted in writing that additional tests be made. The written request includes the Producer's test results and is made within seven calendar days of receipt of the written results of the HMA tests for that lot. The appeal is not accepted if the Producer has not performed any tests that indicate a lower Pay Factor than was determined from the test results by INDOT.

Additional tests for the appeal may be requested for the maximum specific gravity, bulk specific gravity of the gyratory specimens, binder content, or bulk specific gravity of the density cores. One or more of these tests may be requested for the sublot or entire lot. Upon approval of the appeal, the backup samples are tested as follows:

1) Maximum Specific Gravity -- The sample is dried in accordance with **ITM 572** and tested in accordance with **AASHTO T 209**, Section 9.5.1.

2) Bulk Specific Gravity of the Gyratory Specimens -- New gyratory specimens are prepared and tested in accordance with **AASHTO T 312**.

3) Binder Content -- The binder content is tested in accordance with the test method that was used for acceptance.

4) Bulk Specific Gravity of the Density Core -- Additional cores are taken within seven calendar days unless otherwise directed. The core locations are determined by adding 1.0 ft longitudinally of the cores tested for acceptance using the same transverse offset. The cores are tested in accordance with **AASHTO T 166**.

The appeal results replace all previous test result(s) for acceptance of the mixture properties and density.

ADJUSTMENT QUANTITY -- QC/QA HMA

The pay factors are used to calculate a quality assurance adjustment quantity (q) for the lot. A lot pay factor (LPF) for mixture properties and density is determined by averaging the sublot composite pay factors (SCPF) of a lot. The adjustment for mixture properties and density is calculated as follows:

$$q = L \times U \times (LPF - 1.00)$$

where:

- q = quality assurance adjustment quantity
- L = lot quantity
- U = unit price for the material, $/Ton
- LPF = lot pay factor

Example

Lot quantity = 4000 t
Unit Price = $25.00/t
LPF = 1.02

$$q = 4000 \times 25 \times (1.02 - 1.00)$$

$$= +\$2000$$

The total quality assurance adjustments are calculated as follows:

$$Q = Qs + \sum q$$

where:

- Q = total quality assurance adjustment quantity
- Qs = quality assurance adjustment for smoothness as calculated in 401.19(c) of the Standard Specifications
- q = quality assurance adjustment quantity

MIXTURE ADJUSTMENT FACTOR

A Mixture Adjustment Factor (MAF) is used to adjust the mixture planned quantity and lay rate prior to paving operations, and the pay quantity upon completion of production of the mixture. The MAF is calculated by dividing the maximum specific gravity (G_{mm}) from the mixture design by the following values:

Mixture		
9.5 mm	--	2.465
12.5 mm	--	2.500
19.0 mm	--	2.500
25.0 mm	--	2.500

If the calculated MAF is equal to or greater than 0.960 and equal to or less than 1.040 then the MAF value shall be considered to be 1.000. If the calculated MAF is less than 0.960 or greater than 1.040 then the MAF shall be the actual calculated value. The planned quantity and lay rate are adjusted by multiplying by the MAF. The accepted quantity for payment is adjusted by dividing by the MAF.

Example

Mixture	=	9.5 mm Surface
Planned Quantity	=	9,750.00 tons
Payment Quantity	=	9,500.00 tons
Mix Design G_{mm}	=	2.360
Lay Rate	=	110 lb/yd^2

$$MAF = \frac{2.360}{2.465} = 0.957$$

Adjusted Planned Quantity = 0.957 x 9750.00 = 9,330.75 tons

Adjusted Lay Rate = 0.957 x 110 lb/yd^2 = 105 lb/yd^2

$$\text{Adjusted Pay Quantity} = \frac{9500.00}{0.957} = 9{,}926.85 \text{ tons}$$